Sustainable Energy for Economic Development
NORTHWEST S·E·E·D

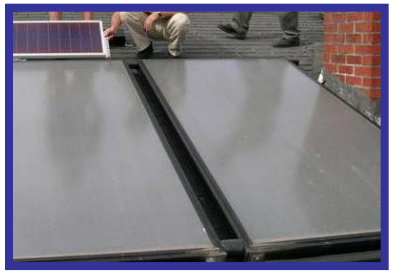
Seattle City Light

City of Seattle
Department of Planning and Development

Seattle Climate Action NOW
SeattleCAN.org

SOLAR AMERICA CITIES
A Partnership Program with the U.S. Department of Energy

Solar Works! In Seattle:
Domestic Hot Water

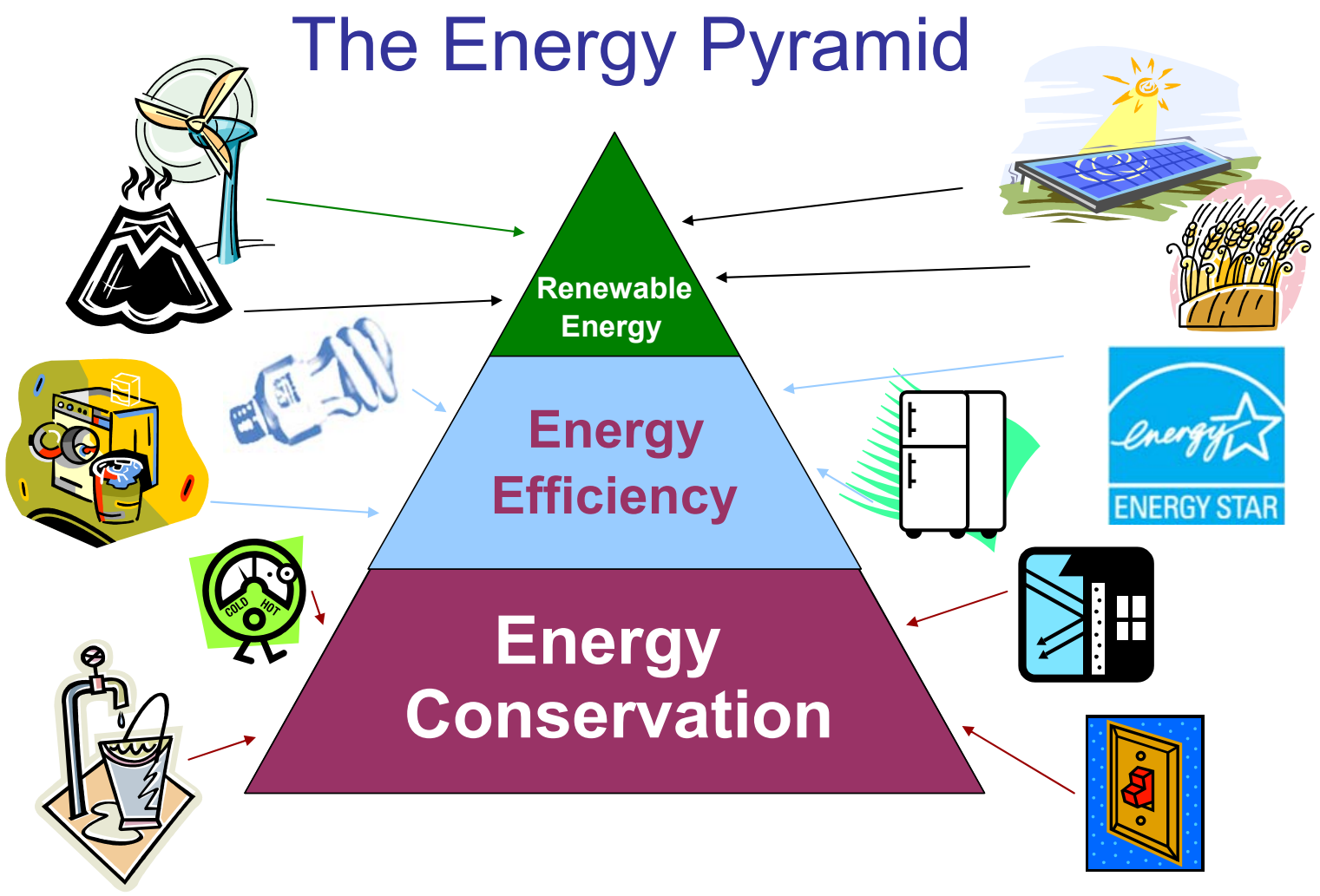


Rainier Community Center
September 19, 2009

Workshop Agenda

- Introduction to solar energy
- Seattle's solar energy resource
- System components
- System configurations and sizing
- Break
- Evaluating your site
- Costs and Incentives
- Getting started- contracting and permitting
- Maintenance

Conservation and Efficiency FIRST!



Benefits of Renewable Energy

- Creates no climate changing emissions
- Cleaner air = better quality of life
- Increases independence from foreign sources of energy
- Contributes to local economies
- Can be a “distributed” energy source

Solar's Unique Values

Photo credit: Sun Wind Concepts
PCC Market in Fremont

Technologies

Solar Energy can be harnessed via:

- Solar Electricity (Photovoltaics, or PV)

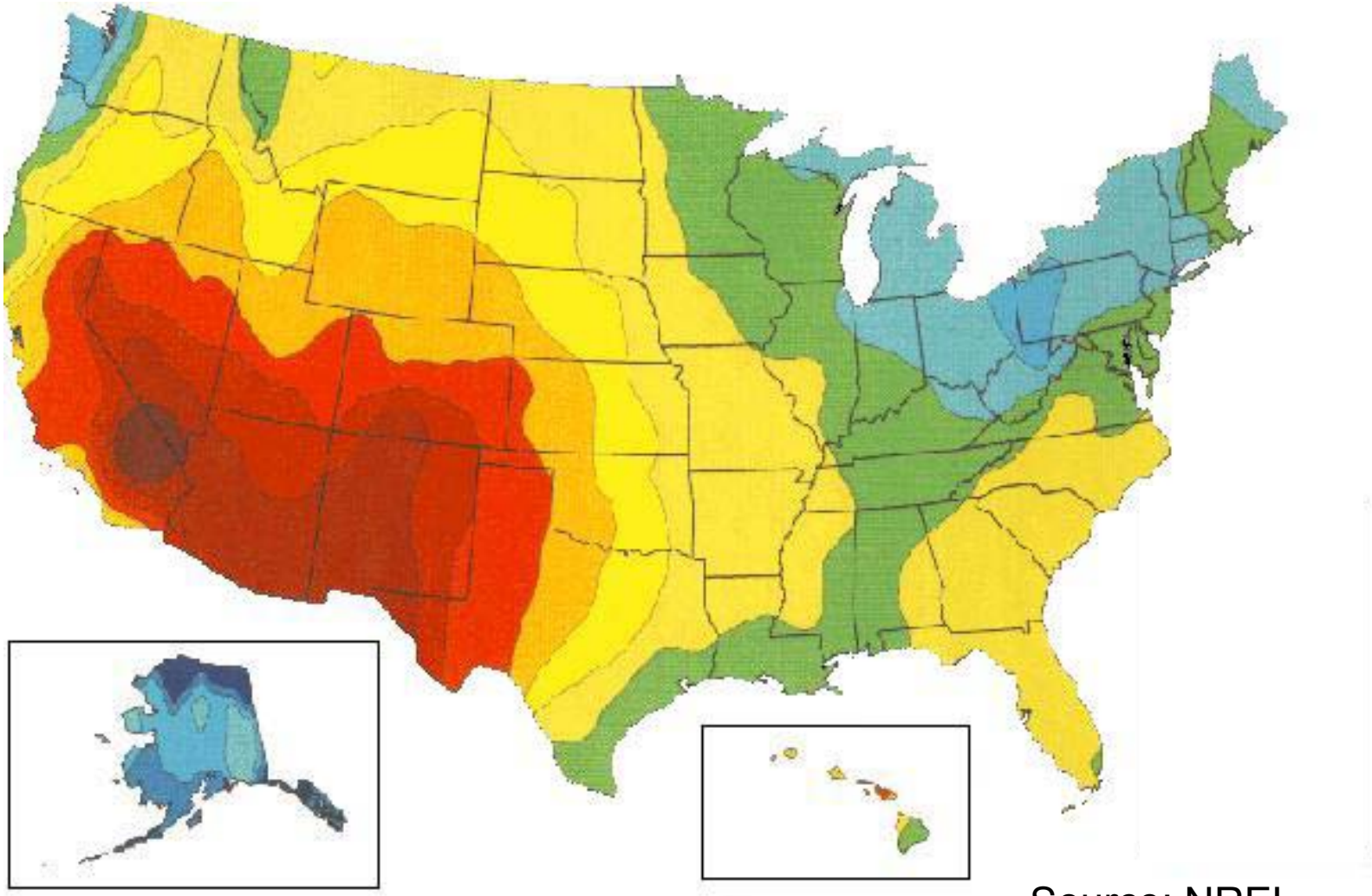
- **Solar Water Heating**

- Solar Space Heating

Does solar energy work here?

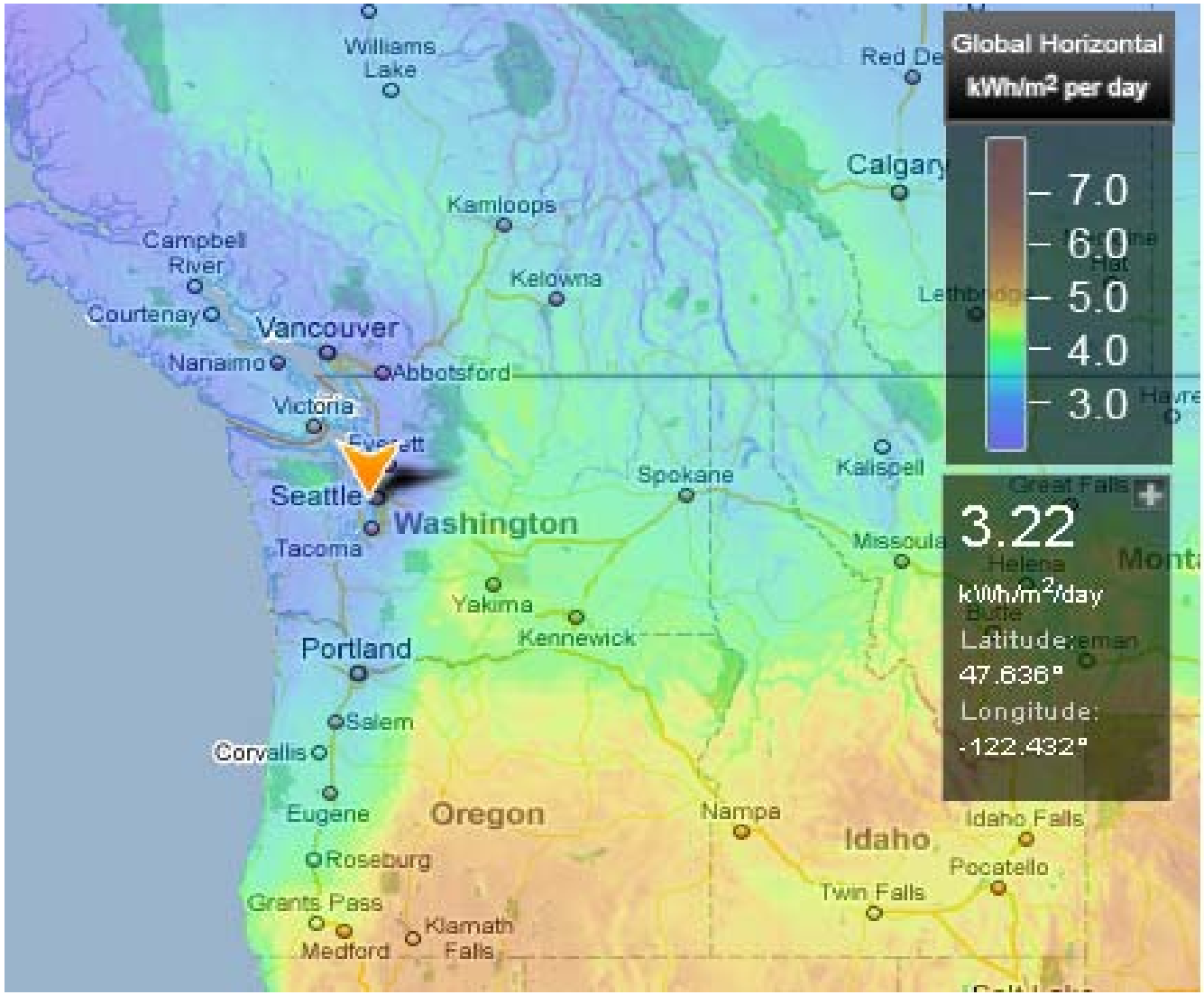
How about here?

Does solar energy work here?



Source: NREL

A Closer Look

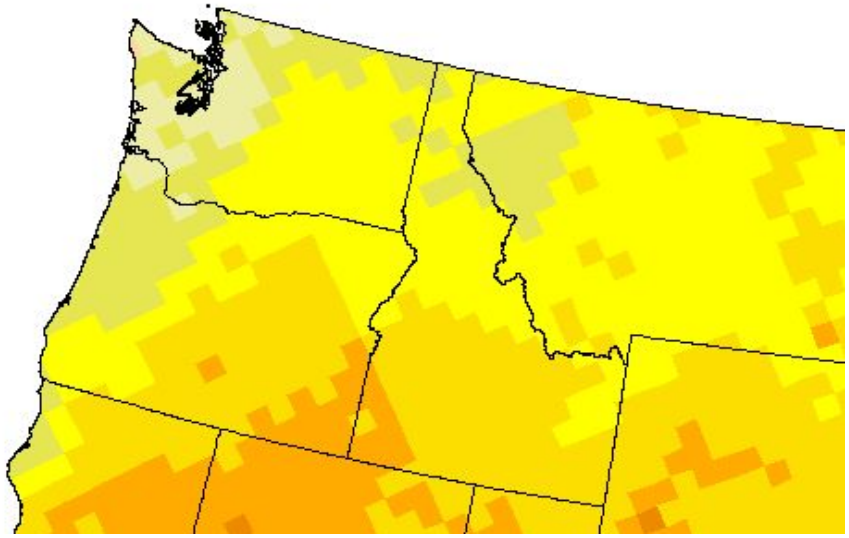


Source: FirstLook from 3TIER

It's All Relative

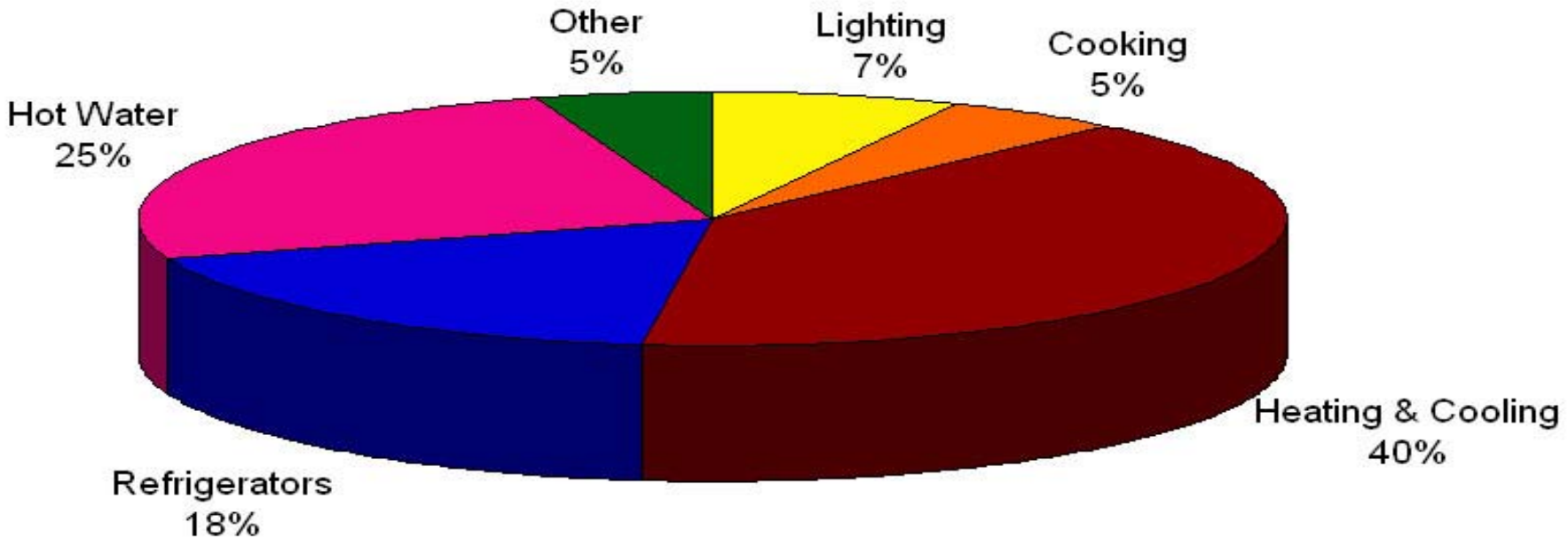
- Average solar radiation in Seattle is 15% greater than in Germany

Germany



Northwest, USA

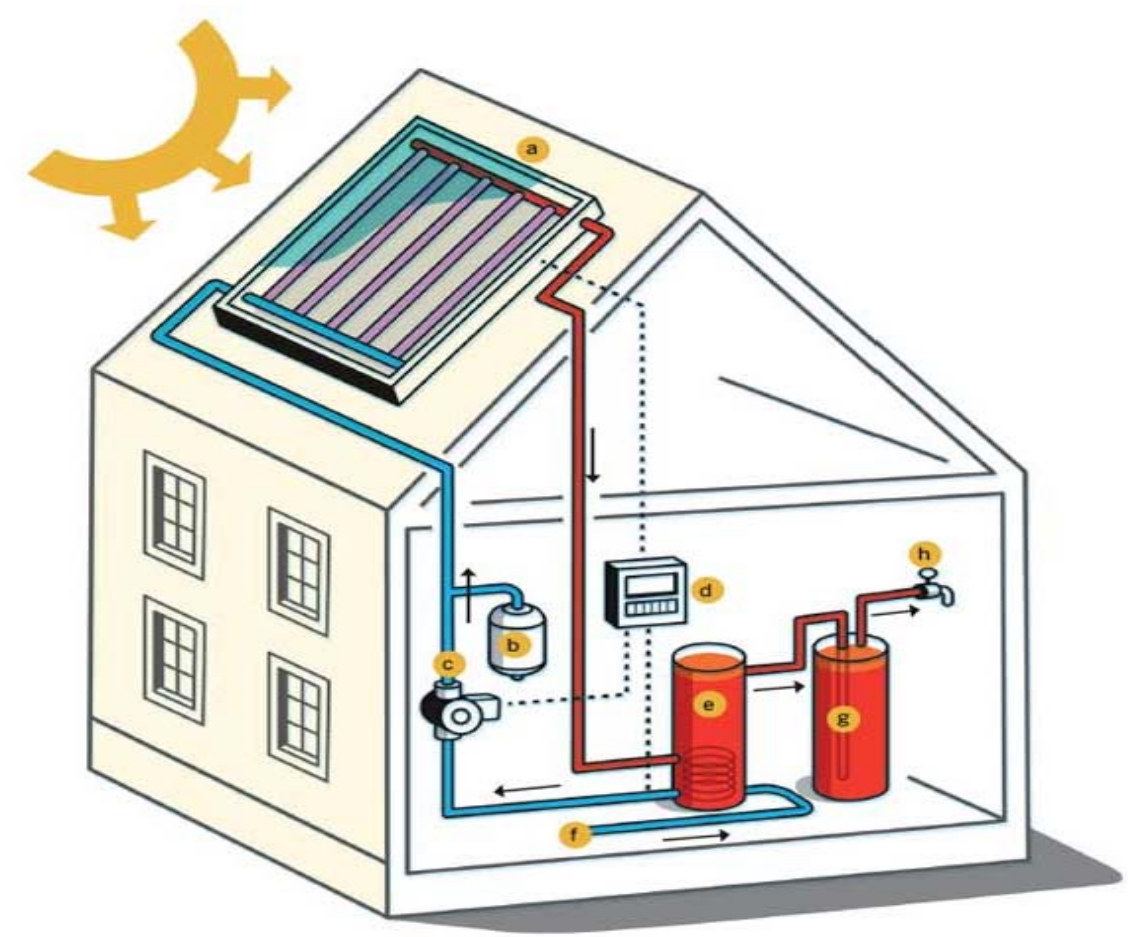
Understanding Your Home Energy Use



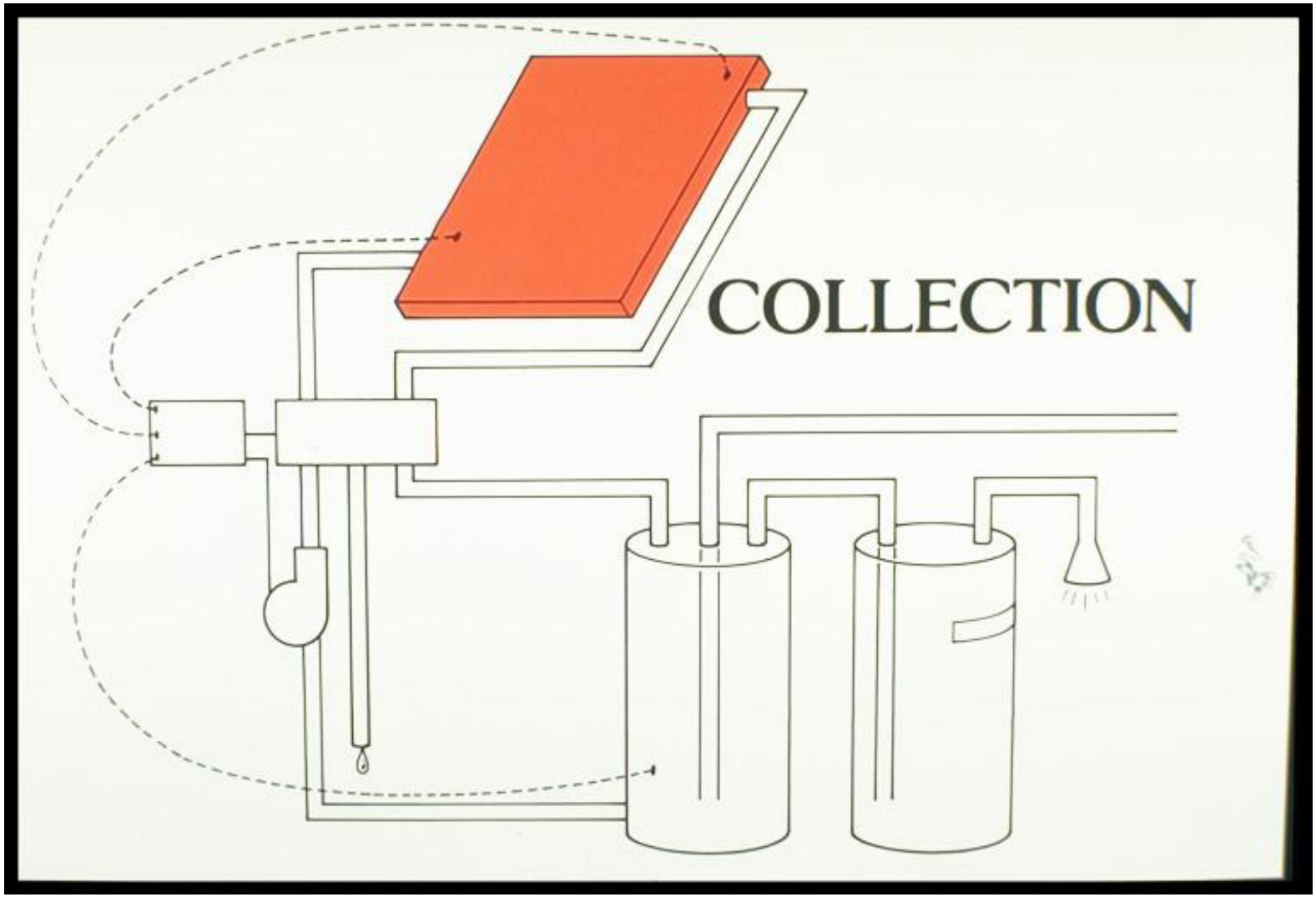
Credit: WA CTED

Can you spot your water heater?

System Components

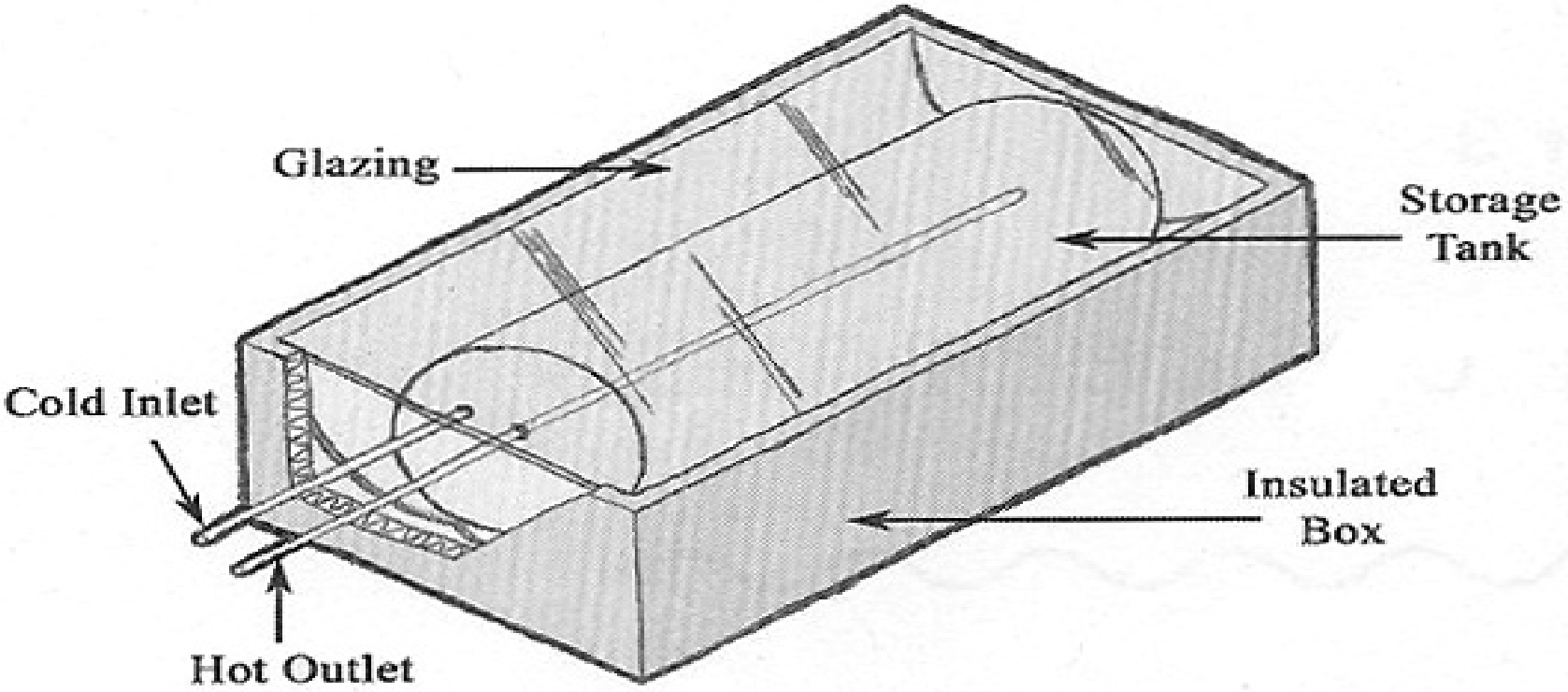


Components: Collection



Collector Types

Batch/ICS Collector

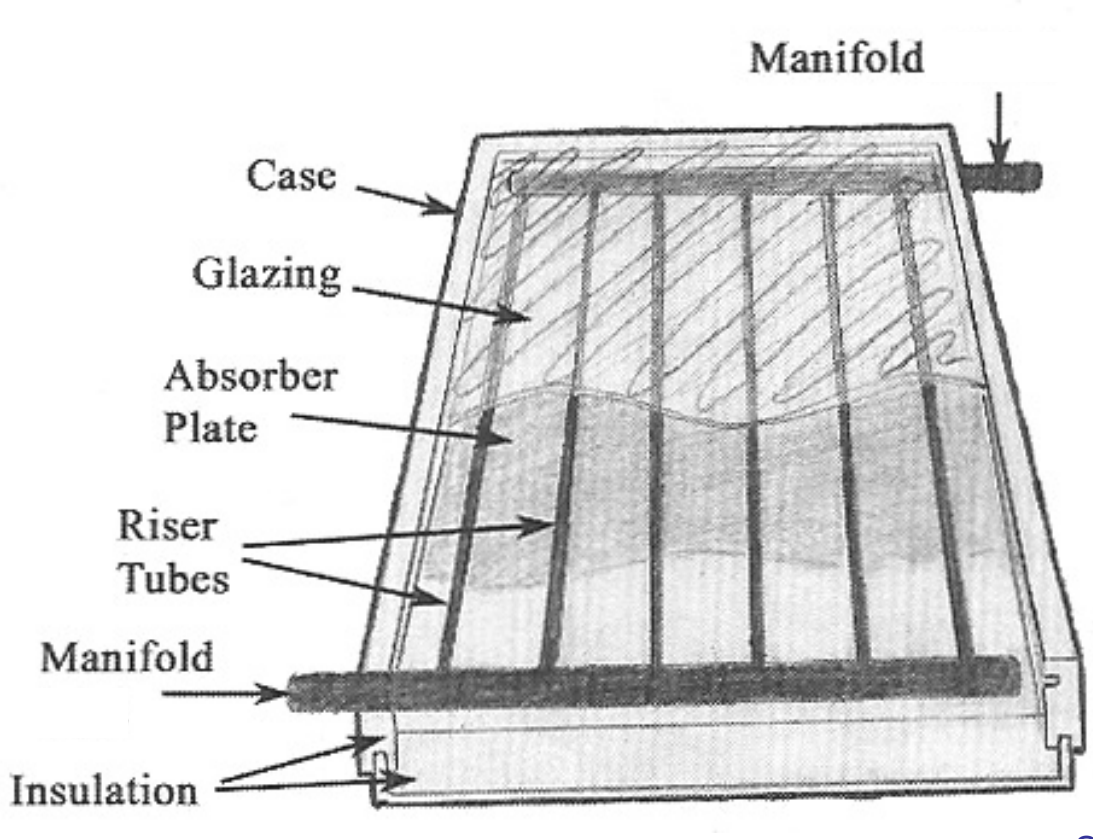


Source: *Solar Water Heating* by Bob Ramlow with Benjamin Nusz

Flat Plate Collectors

Collector Types

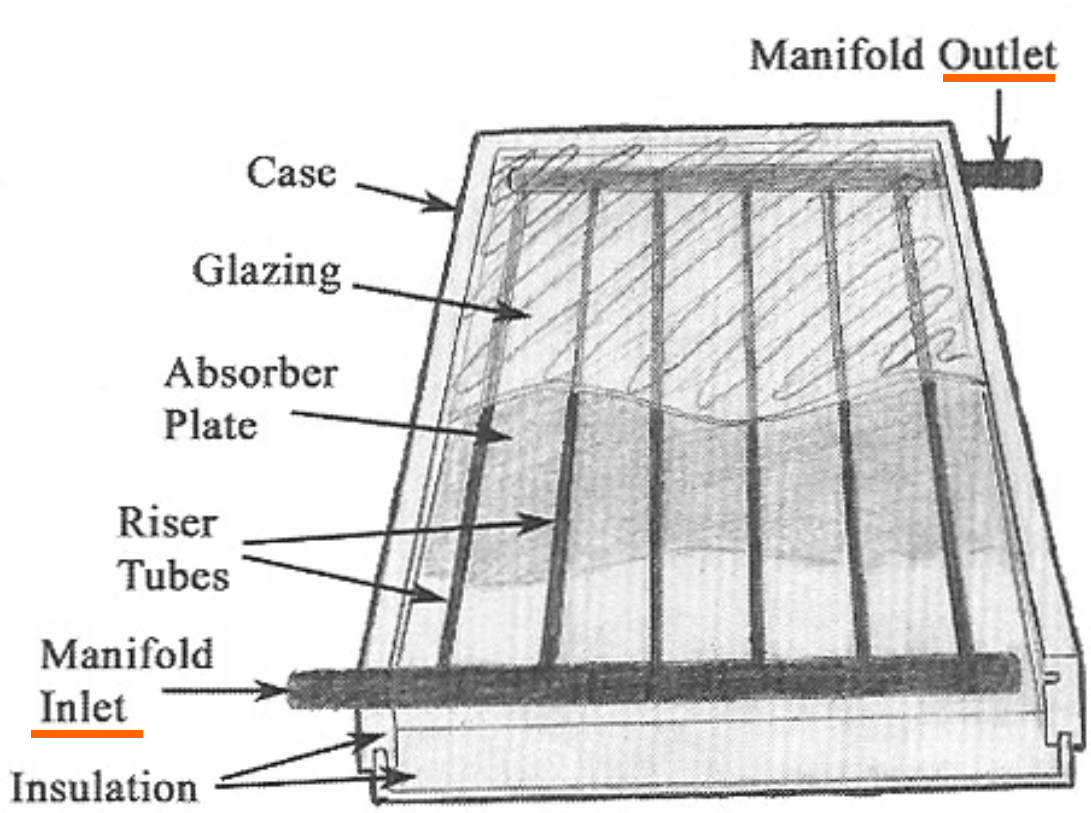
Flat Plate Collector



Source: *Solar Water Heating* by Bob Ramlow with Benjamin Nusz

Collector Types

Flat Plate Collector

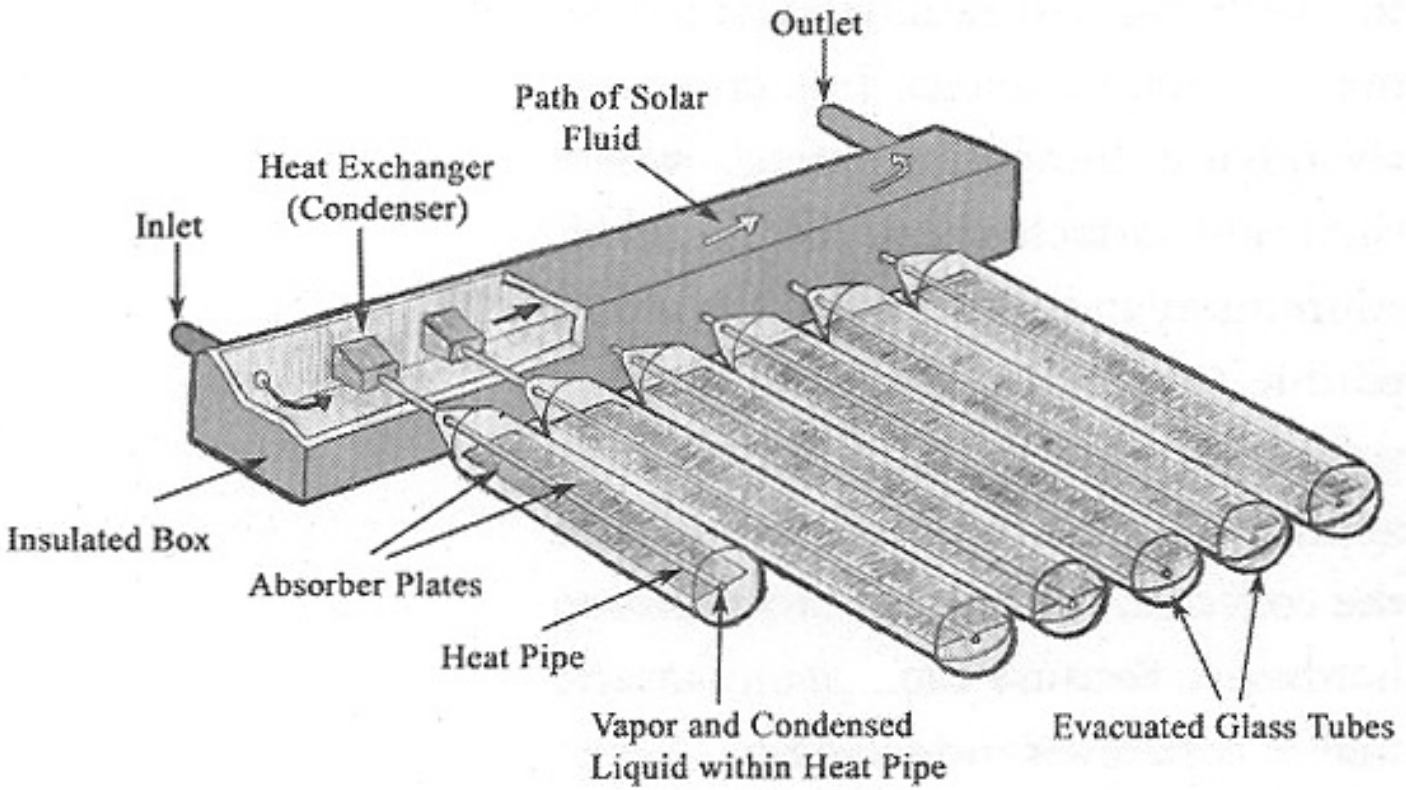


Source: *Solar Water Heating* by Bob Ramlow with Benjamin Nusz

Evacuated Tubes

Collector Types

Evacuated Tube Collector



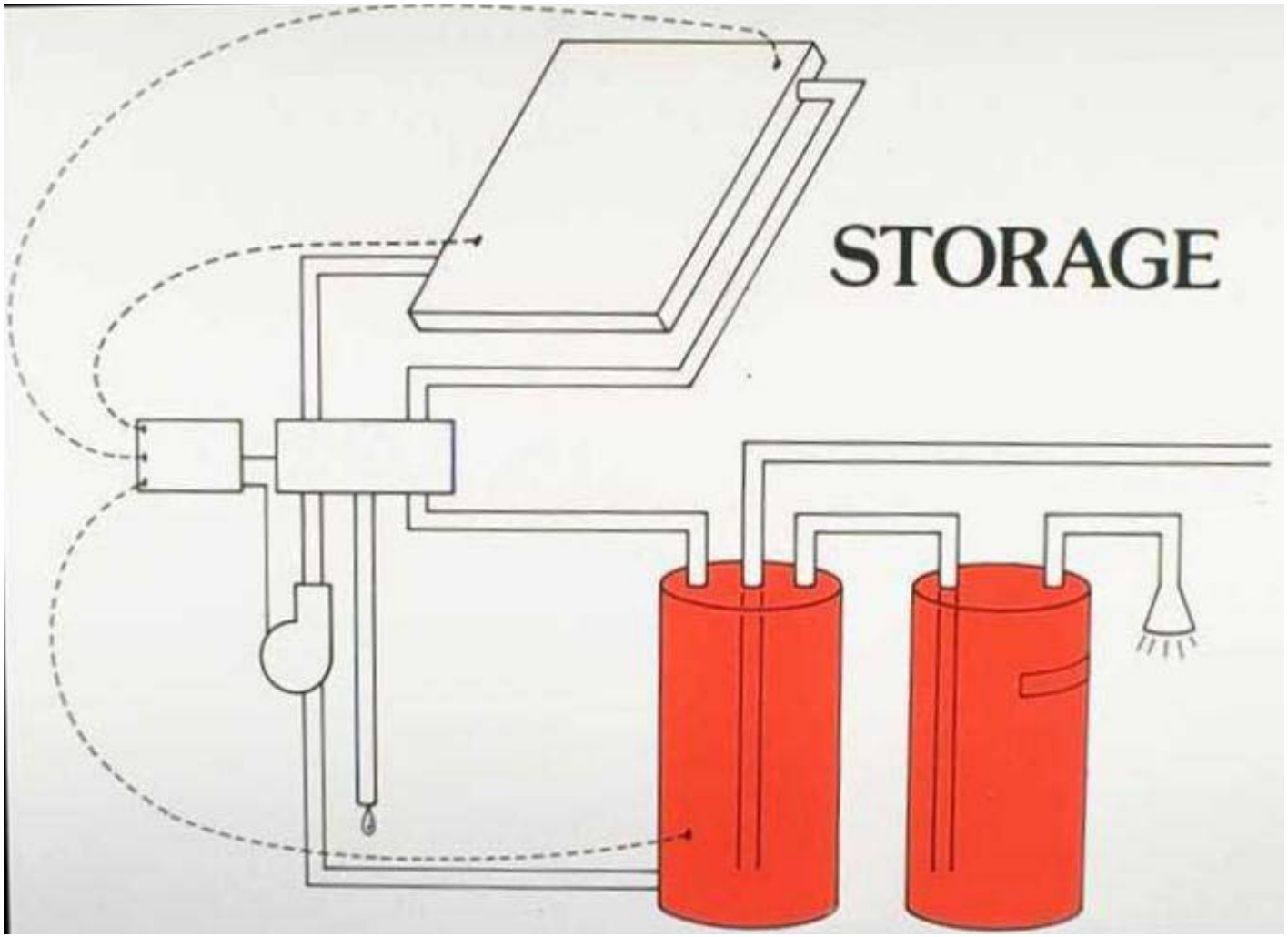
Source: *Solar Water Heating* by Bob Ramlow with Benjamin Nusz

Recap Pros and Cons

	Pros	Cons
Batch System	$	Freeze Night losses Weight
Flat Plate	$$ Efficient Simple, robust	Space required
Evacuated Tubes	Highest temps Cloudy day performance	$$$ Vacuum life

Flat Plate Collectors on Seattle Aquarium

Components: Storage



Tanks

Water heater and
solar pre-heat tank

Solar pre-heat tank with
on-demand water heater

Sizing

- Examine your household hot water use
  - General rule of thumb 20 gals/person/day
  - Or calculate more accurately

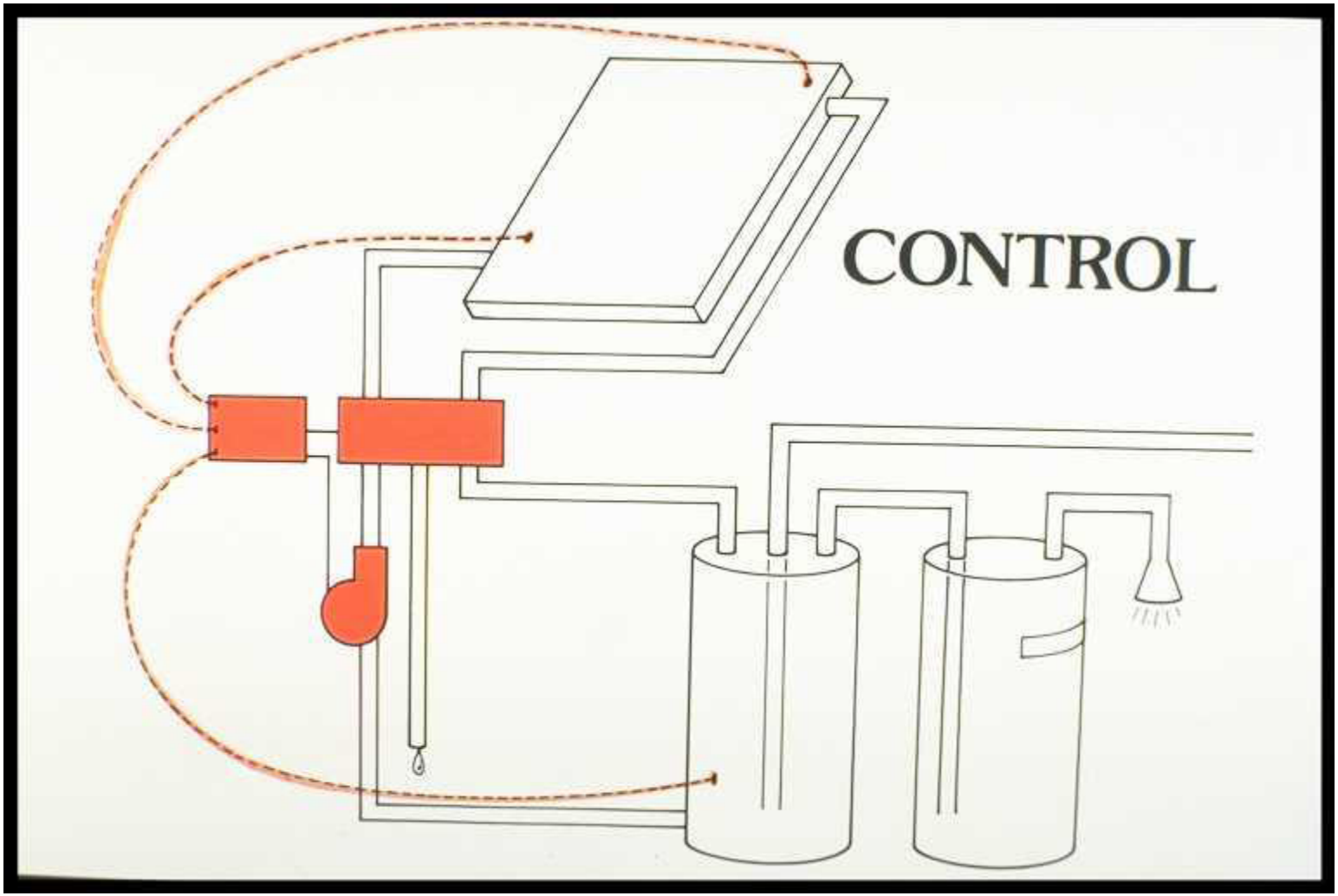
For NW Climate: 1 Collector (or 20 tubes) per 2 people (40 gals)

Approx 1 square foot of collection area, per 1-1.5 gallons of stored hot water

Example: Family of four

2 collectors/40 tubes (60 sf) and 80 gal. storage

Components: Control and Monitoring



Controls, Pumps, and Valves

Differential controller

PV Panel

Temperature sensor

Pump

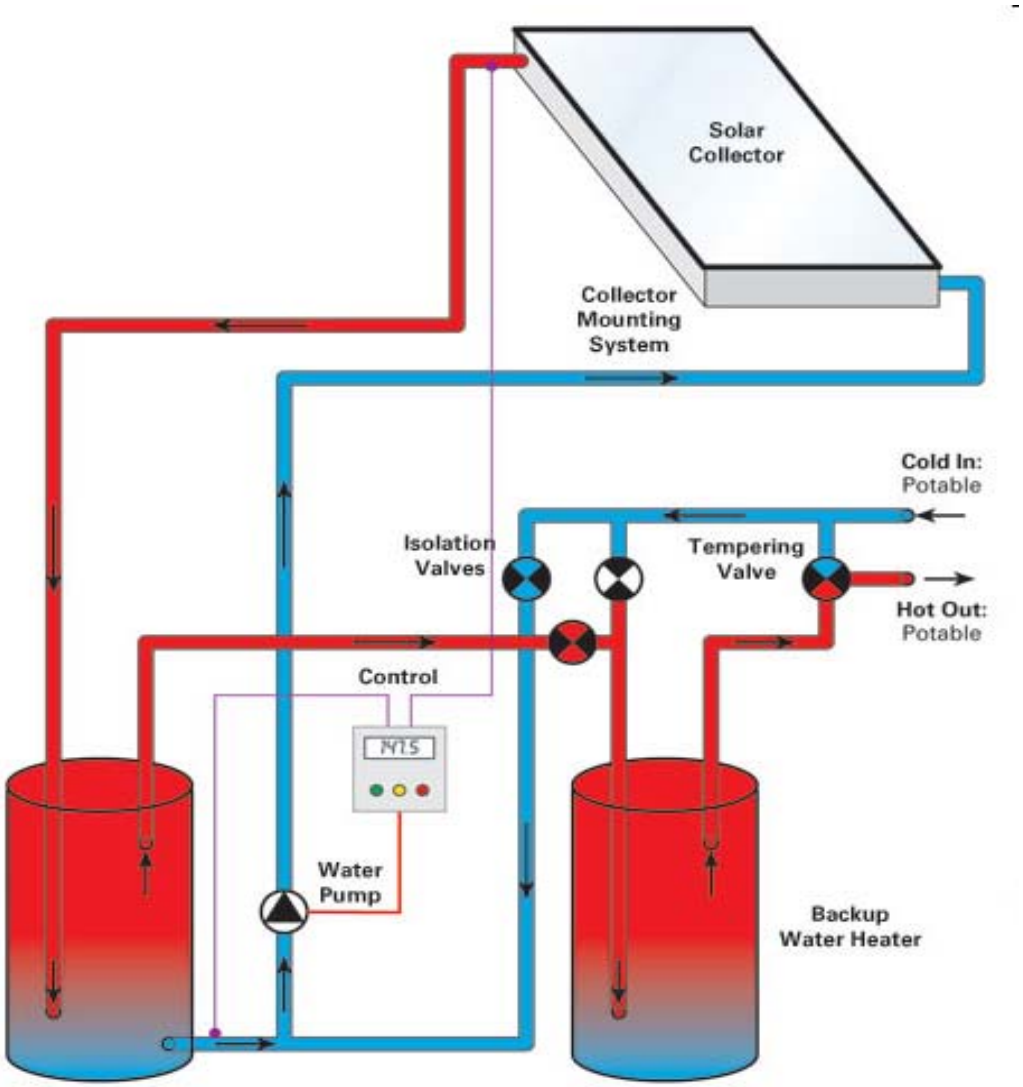
Mixing valve
Air release valve
Pressure relief valve
Drain valve
Isolation valve

Monitoring

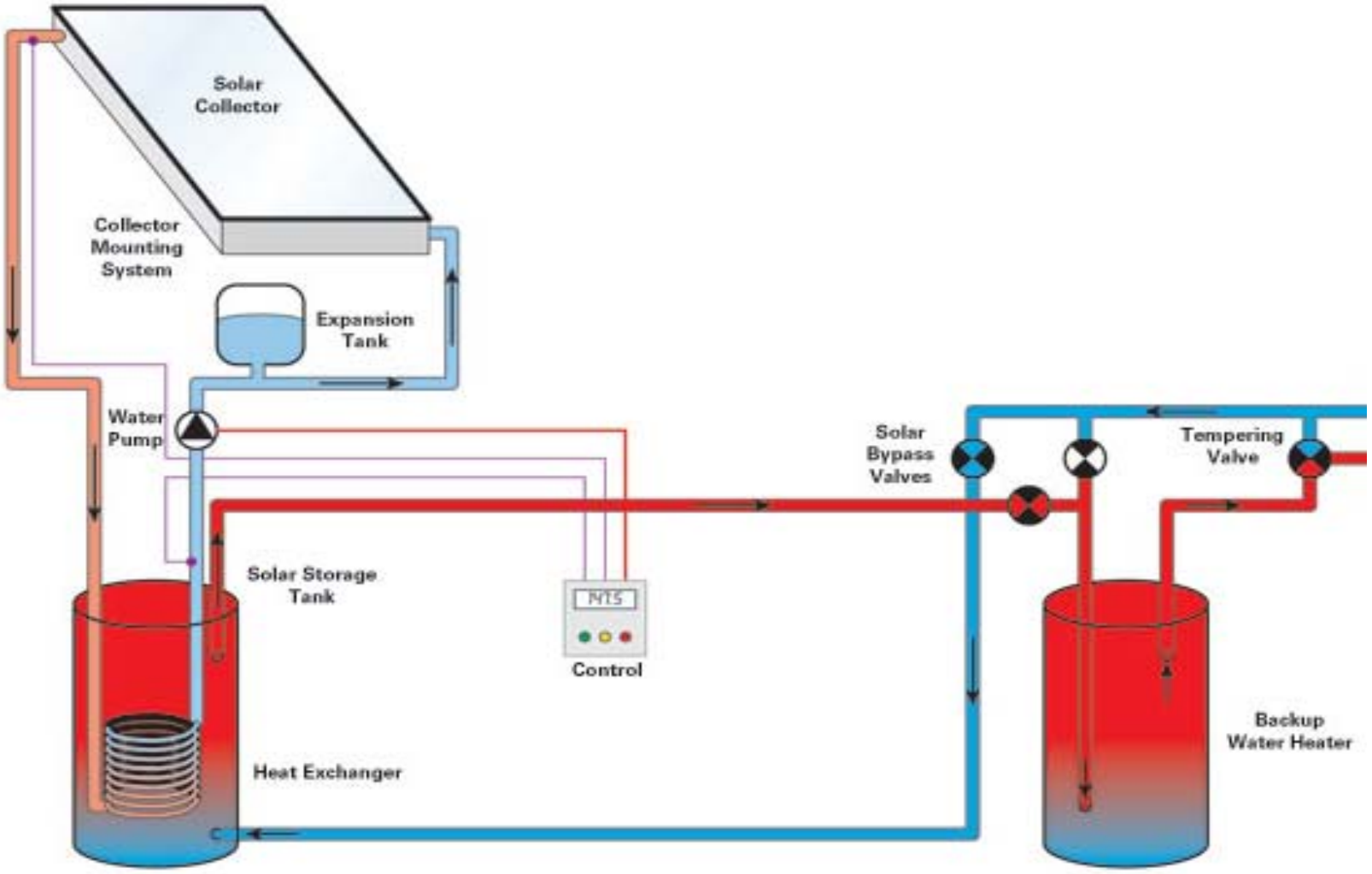
- Thermometer
- Flow sensor

System Components: Mounting Hardware

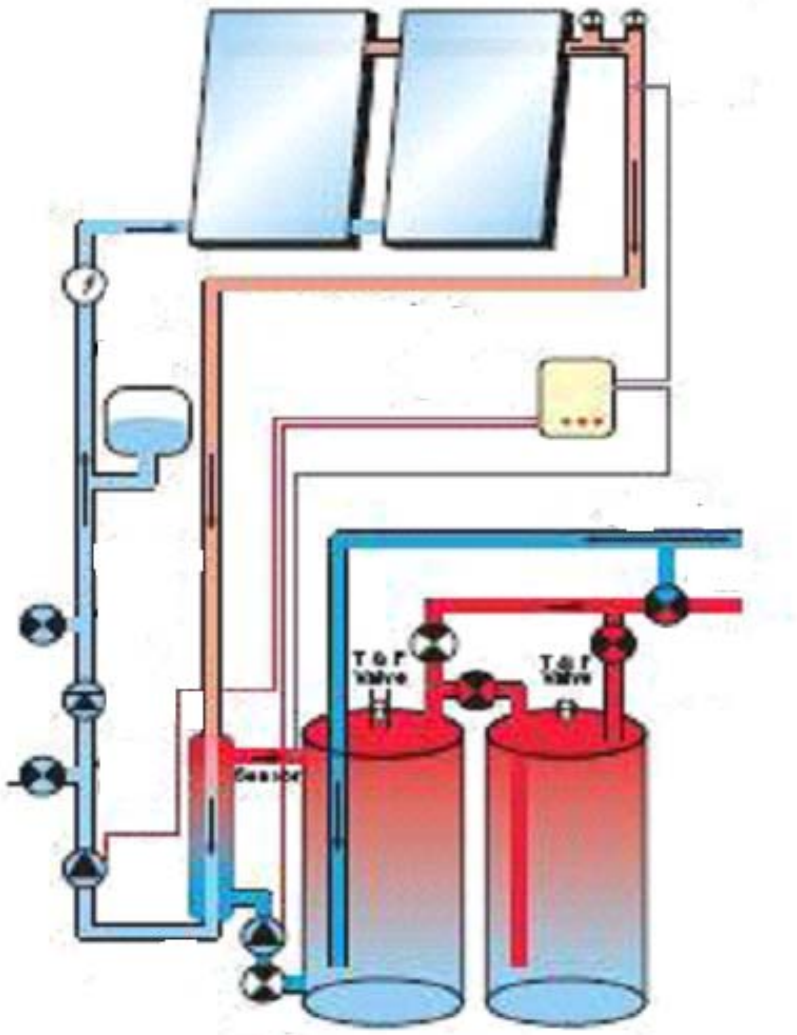
Open Loop (Direct)



Closed Loop (Indirect)



External Heat Exchange



Break…

Will Solar Work for You?

1. What are my goals for going solar?
2. Does my roof face South (or North, East, West)?
3. Are there trees or objects that shade my roof?
4. How old is my roof?
5. How much roof space is available?
6. What is my hot water used for?
7. What type of energy currently heats my water?
8. What size investment can I afford?

Site: Orientation (or Azimuth)

Roofline & street map

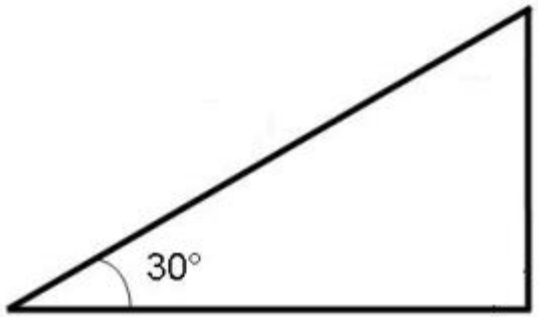
OR

Compass: don't forget about declination

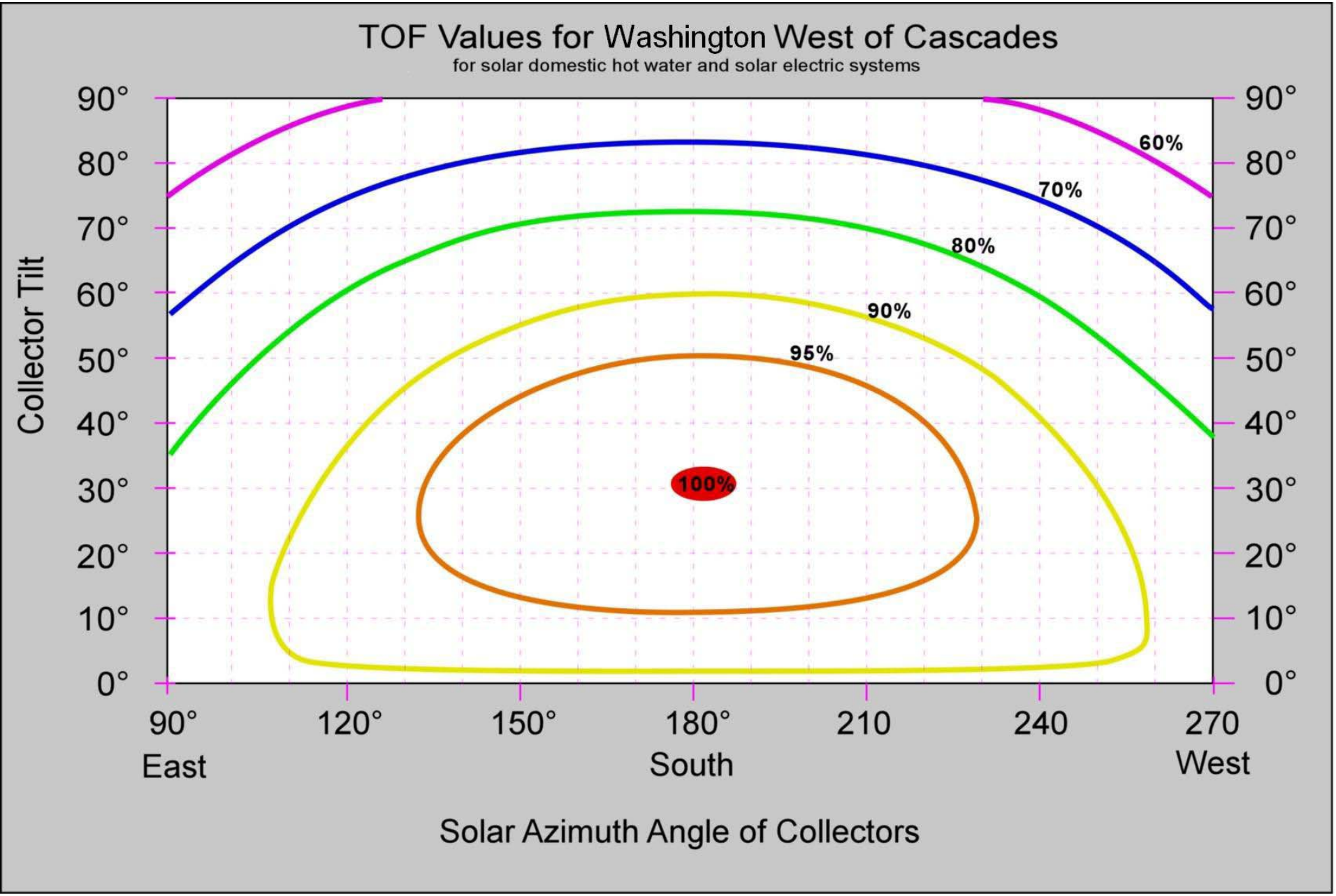
National Geophysical Data Center:
http://www.ngdc.noaa.gov/geomag/

Site: Tilt

Roof pitch tilt	Degrees tilt
3:12	14.0
4:12	18.4
5:12	22.6
6:12	26.6
9:12	36.9
12:12	45.0



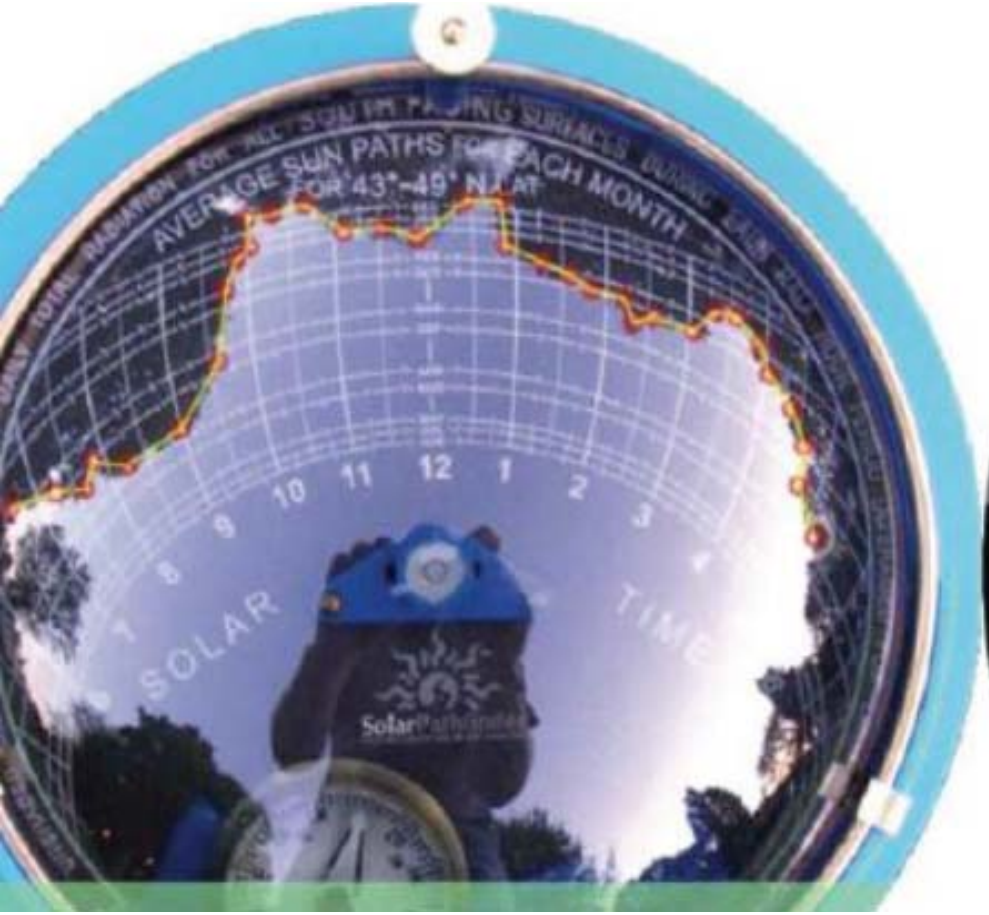
Rule of thumb:
Optimal for solar =
Latitude - 15°.

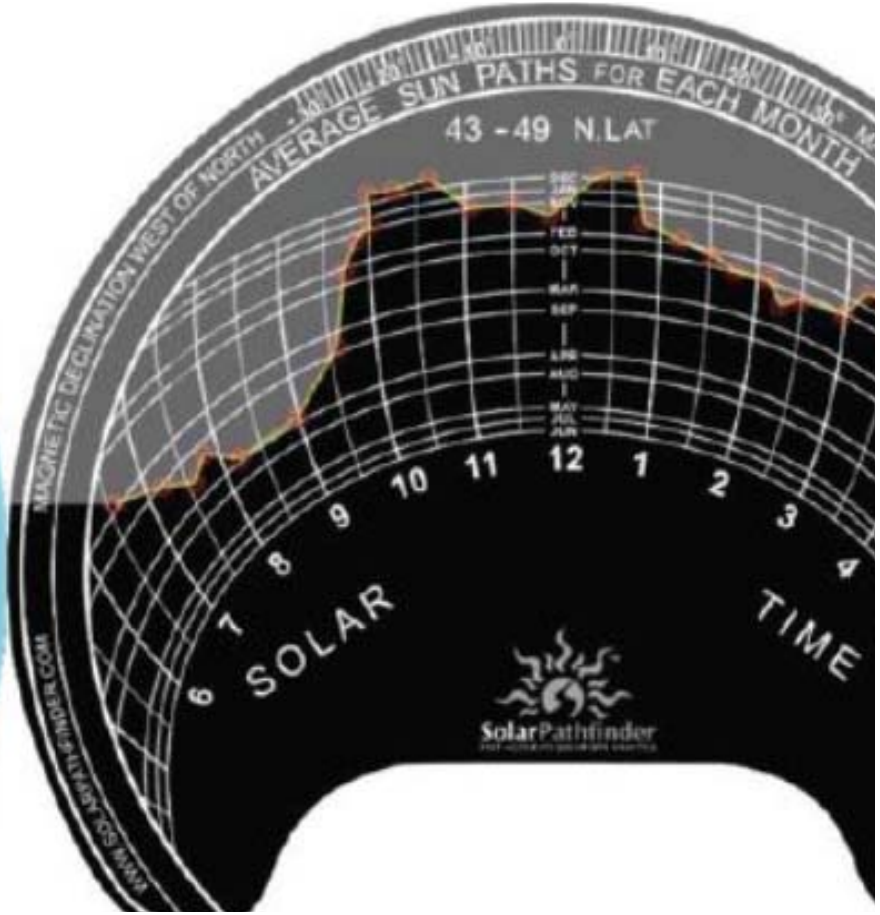

TOF Values for Washington West of Cascades
for solar domestic hot water and solar electric systems
Collector Tilt
90°
80°
70°
60°
50°
40°
30°
20°
10°
0°
60%
70%
80%
90%
95%
100%
90°
East
120°
150°
180°
South
210
240
270
West
Solar Azimuth Angle of Collectors

What NOT to Do

Site Evaluation: Shade

Using a Solar Pathfinder





Total Solar Resource Fraction

(100% -% shading loss)

X (100% -% tilt/orientation loss)

Total Solar Resource Fraction (TSRF)

Example:

- Shading loss = 8%
- Tilt/orientation loss = 12%

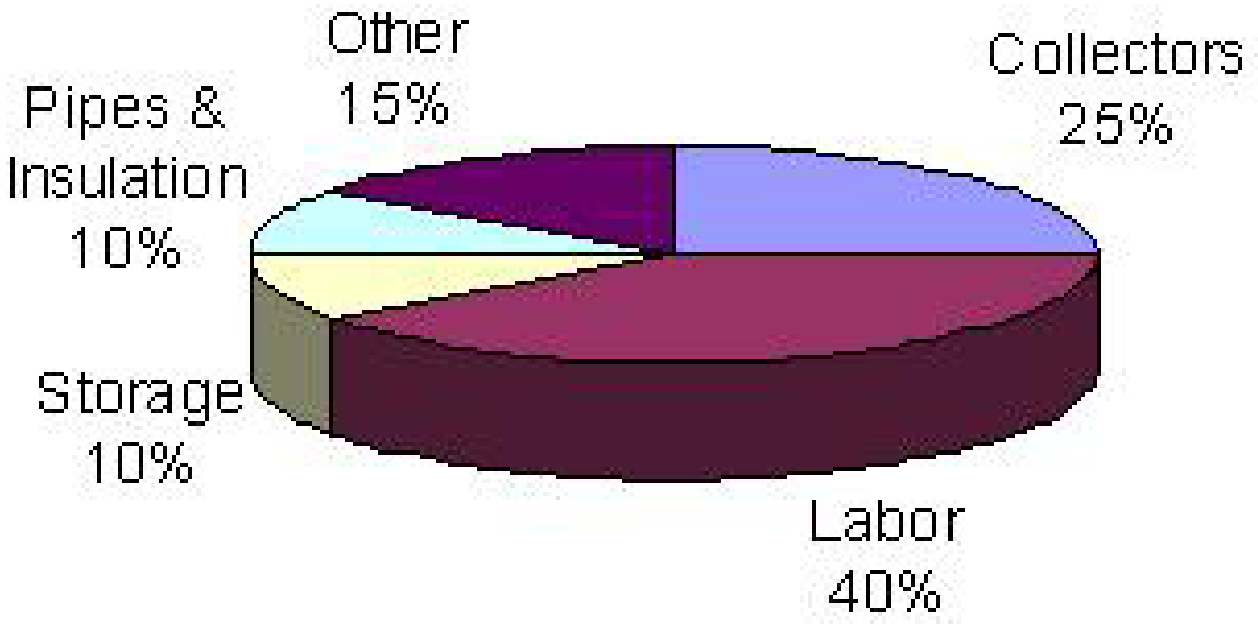
(100% - 8%)	92%
X (100% - 12%)	88%
TSRF = 81%	

Roof Evaluation

- Roof age and condition
- Mounting options for different roof types
- Shading…

Costs

- Average Residential systems installed in Seattle: $8,000-$12,000



Savings

What fuel are you offsetting, and at what rate?

- For electric systems, savings $100-$200/yr
- For gas systems, $150-$200/ yr

The greater the hot water load, the greater the savings.

Financial Incentives

- Federal Energy Tax Credit: 30% of system cost
- State production incentives only apply to electricity generating technologies…

Financial Analysis: Example

Flat Plate Collector System with Electric Backup					
Year	**System Cost**	**Federal Tax Credit**	**Electricity Price**	**Electricity Savings**	**Net Cost**
1	($10,000)		$ 0.07	$ 154	($9,846)
2		$3,000	$ 0.08	$ 166	($6,680)
3			$ 0.08	$ 180	($6,500)
4			$ 0.09	$ 194	($6,306)
5			$ 0.10	$ 210	($6,097)
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19			$ 0.28	$ 615	($617)
20			$ 0.30	$ 665	$47

Identifying a Contractor

- Solar Washington/ASES members
- NABCEP certification
- Get three bids
- Look for:
  - Cost and long-term financial assessment
  - Performance estimates
  - System design
  - Warranties
  - Services included

Resource: www.solarwashington.org

Permitting

- Permitting process:
  - Plumbing permits: Approved at DPD by Seattle/King County Health Department- $115
  - Building Permit required if >1000 pounds, or significant changes to roof structure
  - CAM 420: Client Assistance Memo for Solar Energy

Maintenance

- Occasionally check temperature gauges and flow meter
- Occasionally check for pump operation on sunny day
- Antifreeze systems: change antifreeze and expansion tank every 8-10 yrs
- Prevent overheating during vacation

When to call your contractor

- Not enough or no hot water
- Water too hot
- Tank leakage
- System will not turn on
- Solar system runs continuously
- Noisy pump operation

Learn More…

Next Event:

ASES Solar Tour October 3rd!

Online Resources:

- www.seattle.gov/light/solar
- www.nwseed.org
- www.solarwashington.org
- www.dsireusa.org